MODIFICATION OF SURFACES BY FUNCTIONAL SILICONES

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ABSTRACT

The method of molecular assembly both of micro/nano-dimensional biocidal 1,6-di(guanidinhydrochloride) hexane-containing and electroconductive thiophene-containing silicones coatings immobilized onto the surface of materials has been developed. Some physicochemical properties of these surfaces were studied.

Key-words: Thiophene-containing silicones, 1,6-di(guanidinhydrochloride)-hexane, molecular assembly method, biocides, fungicides, electroconductivity.

INTRODUCTION

Elaboration of chemical construction methods of molecular and macromolecular structures, including nano\micro-sized ones, on the basis of functional organoelement and organic compounds on synthetic and natural polymer surface allow to impart to polymers such relevant properties as hydrophobility, hydrophility, biocidity, repellent properties as well as sorption activity, flame-resistance and incombustibility, photoluminescent properties etc. at the very small expense of starting compounds.

Traditional chemical modification of synthetic and natural polymers for directed changing their properties consist of introduction of different compounds into the structure of macromolecules or into the bulk of polymer. A new approach is based on the introduction of such modifiers on polymer surface by the method of chemical molecular construction of microamounts of organoelement and organic compounds, resulting in the formation one or a few molecular layers, including nano\micro-sized ones.

Directed regulation of polymer properties is achieved by means of layers structure. thickness and quantity variation, as well as their order. Because of chemical bonds formation, nano\micro-coatings are fixed and held on the polymer surface. Typical coating thickness range from monomolecular layer to 10 nm and above.

In case of such organoelement compounds as organosiloxanes with sili-

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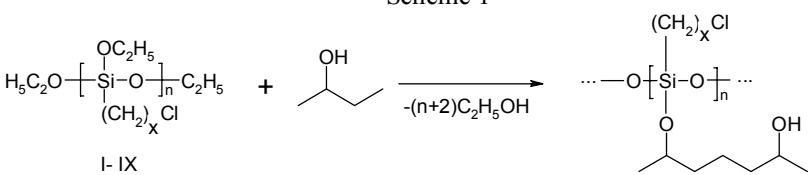
con-bound alkoxy- and silanolic groups, the latter connect to the polymer surface by means of reaction of alkoxy- and silanolic groups with polymer functional groups (hydroxylic, carboxylic et al.). If silicon atoms of the first layer bear carbofunctional groups, such as amino-, epoxy, halide alkyl, olefin etc., their capability to further chemical transformations can be used for construction of covalently bonded to the material second-layer nano\micro-sized coatings on the siloxane layer surface, and for construction of the next organic, organoelement and inorganic layers. This approach makes it possible to create new generation of sandwich nanosized hybrid materials with given thickness, composition and structure. As a result, initial polymers with modified surface acquire a complex of necessary physicochemical properties.

EXPERIMENTAL PART

Polyorganosiloxane coatings have been synthesized by the molecular assembly method in two stages. At the first stage the immobilization of oligo(chloroalkyl)ethoxisiloxane (I-IX at *scheme 1*) has been made on the surface of materials by treating them with a solution in an organic solvent or with the water emulsion of oligomer (I-IX) with a specified 0,01; 0,1; 1,0; 3,0%- concentration, with air-drying; after that the modifier was fixed by 100^0C heat-treating during 10 minutes or it was kept in the air at the room temperature during 24 hours. The characteristics of oligomers are given in the article [1].

In the result of the mentioned treating the modifier (I-IX) was covalent fixed on the surface of the material because of the condensation of ethoxygroups of the modifier with the functional groups of polymer material while building an grafted micro/nano-sized polyorganosiloxane coating on the surface (*scheme 1*).

Scheme 1



where n = 5, x = 1 (I), 3 (II), 4 (III); n = 10, x = 1 (IV), 3 (V), 4 (VI); n = 15, x = 1 (VII), 3 (VIII), 4 (IX)

The amount of polyorganosiloxane coating on the surface of the material have been defined after the impregnating, drying and thermal treatment according to the increased weight of material expressed in percentages from the initial mass of one. If after an one-time impregnation, drying and thermal treatment of the material the increased weight did not reach the required value, then the impregnation, drying and thermal treatment of the materials have been conducted some times more and it has been continued until an increased weight

with the required values was reached.

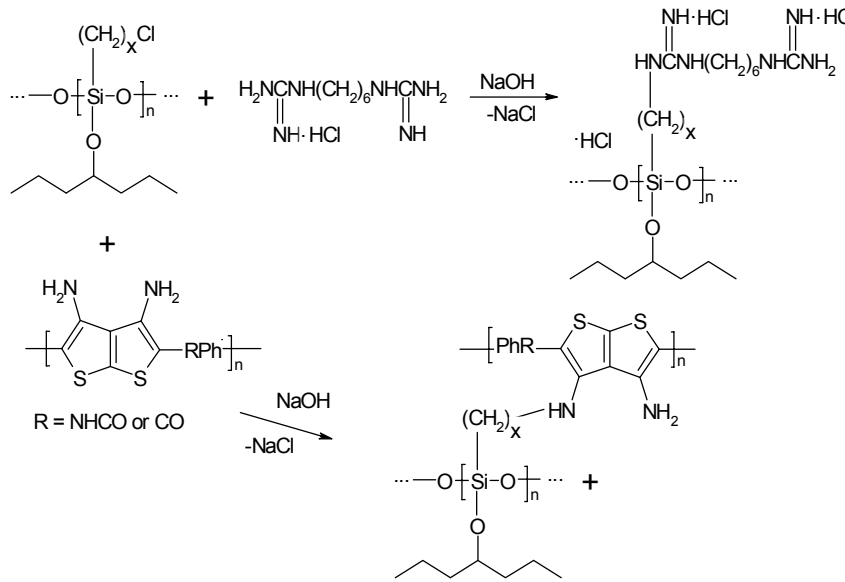
At the second stage the condensation of the grafted poly(chloroalkyl)organoxsiloxane coating with 1,6-di(guanidinhydrochloride)-hexane in a alcohol solution with the presence of alkali at the room temperature was carried out.

Polymeric thiophene-containing coatings were prepared via curing of thiophene-containing silicones on a 50-μm-thick polyarylate film cast from chloroform.

RESULTS AND DISCUSSION

As the result of a two staged treatment the grafted coatings materials which contain 1,6-di(guanidinhydrochloride)-hexane and polythieno [2,3-b] thiophenes groups (scheme 2) were obtained.

Scheme 2



The presence of guanidine groups in the coating gives to the material a high biocide activity.

Such coatings are very effective for bacteria E. coli, P. Aeruginosa, fungi Penicillium chrysogenum, Aspergillus niger, yeast spores Saccharomyces cerevisae, as well as for other bacteria, fungi and yeast spores.

The presence of polythieno[2,3-b]thiophenes groups in the coating gives to the material a high electroluminescent properties.

CONCLUSIONS

New approaches and principles of the creating of layered micro/nano-sized functional polysiloxane coatings of the given structure, composition and texture, which are immobilized on the surface of materials allow to enhance the efficiency of the practical using of such materials, to improve their quality and field-performance data.

Acknowledgements

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REFERENCE

[1] T.N. Rodlovskaya, B.A. Izmailov, V.A. Vasnev et al., Polymer Science, Ser. B, 2011, Vol. 53, Nos. 5-6, P. 325-357.